Lightning Conductors.

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Notes on Material and Method of Erecting in the Straits Settlements.

1. The number of many-branched terminals and massive rods and cables of pure copper which adorn most of the buildings, indicate that the importance of attempting to safeguard against the effect of lightning discharges is generally appreciated. A study of the attempts too frequently reveals a considerable lack of knowledge of modern methods.

2. Numerous cases which have come under the writer's observation are applications of a theory, which obtained general credence twenty or thirty years ago, that a conductor "protected" a defined area bearing some direct relation to its height. A "law" to this effect was actually laid down and found many adherents ——possibly because of its simplicity.

3. In other cases a quite disproportionate amount of attention is paid to the earth connection, sometimes at the expense of the material and work above ground. Tests which show a resistance of more than an ohm or two, though made, frequently, during dry weather, are often considered sufficient to condemn a conductor satisfactory in other respects.

4. The writer has been called upon to inspect a large number of conductors upon Government and Municipal buildings during the past few years, and is forced to the conclusion that, in a large majority of instances, much greater protection could be provided for a smaller initial outlay.

5. To illustrate this the case of a certain powder magazine in the Colony may be cited. As is usual for buildings of this sort, very considerable care had been exercised by the Authorities in the provision of elaborate conductors-and a very considerable sum expended upon material and work. Broad strip of pure copper is the material used and this is run along the main

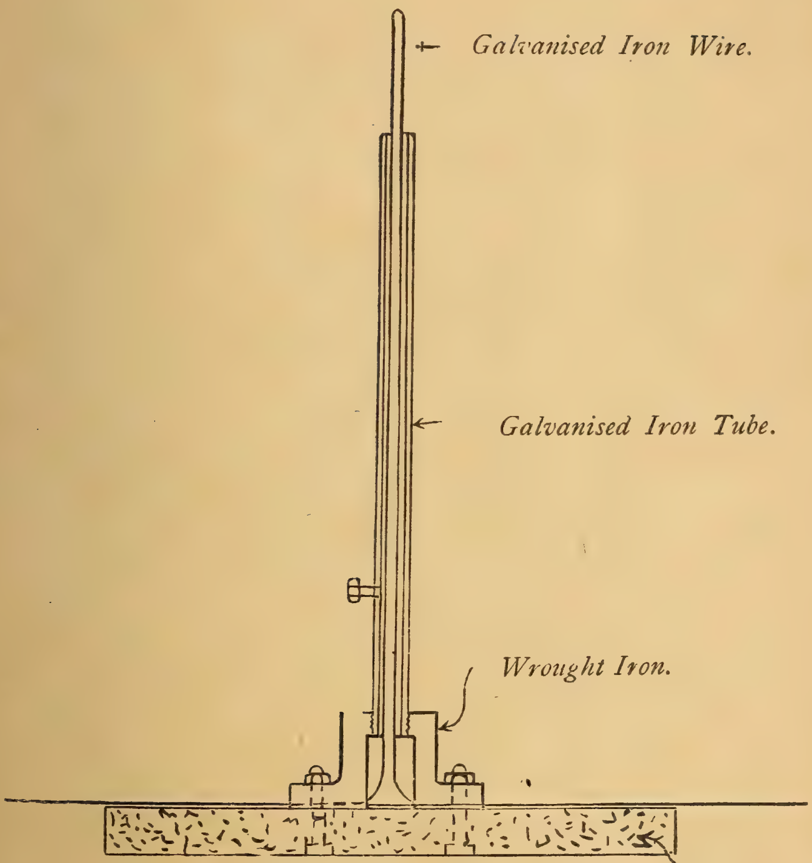
ridge of roof and connected to eight points from which similar strip is taken down to eight earth connections. As the brief suggestions which follow may serve to indicate, seven of these "earths" are quite unnecessary and, further, had an equivalent weight of copper been used in the form of a light stranded wire, very much better protection would be afforded.

6. The determination of the size and section of the conductor, whether of copper or iron, depends more upon mechanical strength and durability than conductive properties. There is little danger of the wires becoming melted and, if the system is inter-connected, the fusion of certain lengths would not affect the utility of the conductor as a whole to any serious extent. The network advocated by the writer would deal with succeeding discharges whereas a break in a single conductor has frequently been the cause of damage. Fusion of part of the network would not escape notice and, in a sense, would be satisfatory in affording proof that the conductor had seen active service.

7. The material used by the writer is galvanised iron in the form of a light cable composed of seven strands of number sixteen gauge wire. (7/18) This affords ample mechanical strength, is pliable and unobtrusive in appearance. Zinc saddles are used to secure it to ridges of roof and down walls to earth. It is frequently possible to make use of the down pipes from roof gutters by running the conductor through them.

8. In order to make the system as far as possible jointless as regards the work on the roof, which usually escapes supervision, the writer has recently designed a tubular point through which the conductor itself is drawn, doubled, and allowed to project an inch or so from the top. A set-screw at the base provides sufficient contact without the necessity of soldering—often so awkward an operation on a roof that it is left undone altogether. The point is practically formed of the conductor itself and joints become unnecessary above ground.

9. The number of points and the amount of wire used for any building must depend upon the degree of safety desired and the funds available for providing it. The fact that many points and much wire mean better protection should be thoroughly recognised. In practice something must be sacrificed to



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appearance in the case of ordinary buildings and the multiplication of points, even of the short pattern now advocated, cannot be carried to excess. Prominent ridges should be provided with one for every fifteen or twenty feet of length ; every corner should also have its point and all should be connected together and to the "earth."

10. This connecting up of points results in a net-work over the whole roof which forms the nearest feasible approach to the continuous metallic screen held by modern views to constitute an absolute safeguard.

11. As suggested in paragraph 7 the down pipes from rain guttering may frequently be used for bringing down the wires from roof net-work to earth. The connection to roof net-work should be made by inserting the wire into a corner point, where it will meet two net-work wires. Soldered joints will still be unnecessary as the wires will be in close contact throughout the length of the point.

12. The question of earth connection has next to be considered. This is usually held to be of primary importance and various rules are laid down which state the exact maximum resistance permissible. It is, no doubt, desirable that the resistance should be reasonably low so that disturbance may be avoided, but whether it be of two ohms or fifty matters very little. The effect of a poor earth connection was recently demonstrated at the Civil Prisons in Singapore, where a discharge taken by the conductor blew out the soil over the earth connection, leaving a hole about three feet in diameter and two deep. This earth was formed of the coiled end of the conductor—a heavy galvanised iron cable—and was buried to a depth of a couple of feet only, on a slope. Moist soil would have been reached by taking it a little further away to lower ground and burying it a little deeper, but, on enquiry, the writer found that the workman responsible had miscalculated the length required, cut the cable and hurriedly buried the end. The instance serves to show that no great harm results from imperfect earth connections if they are placed sufficiently far from foundations.

13. It is rarely a matter of great difficulty or expense—especially where galvanised iron is the material used—to continue the conductor to permanently damp earth. If it is laid

in a strench twelve or fifteen inches deep, and taken to a point not less than one hundred feet from the building where damp soil may be reached without an excessive amount of excavation, the earth connection may be said to be perfect. By taking the conductor this distance from the building not only is the risk of damage due to disturbance near foundations averted, but an increased area of earth connection is obtained.

14. Except in the case of very small buildings it is advisable to have at least two connections between the roof net-work and the earth. In extensive buildings the writer has made a practice of bringing down six or more. In these cases it is occasionally necessary, from motives of economy, to join the down wires together and continue one only away to the "earth" There is no difficulty in making thoroughly good, soldered joints in galvanised cable on terra firma, but, if funds allow, it is a much better plan to have a continuous trench round the building into which all the down wires are taken and then continued, laid up together, away to the deep "earth."

15. As regards the comparative cost, it is interesting to note that, for the same outlay not less than twenty-five times as much surface can be covered by the stranded galvanised wire suggested as would be by a single copper rod of one inch in diameter, such as is frequently used. In fact it is perfectly safe to state that, taking into consideration the increased amount of labour, and additional details and accessories, required for net-work system, quite twenty times better protection may be obtained for the same outlay.

16. Many interesting illustrations of the inefficacy of single conductors for complete protection may be quoted from local records. In one instance, which came under the direct observation of the writer, some damage was done to the part of the roof of an extensive range of buildings on which three independent conductors were fitted. Such cases afford sufficient proof that single conductors do not effect their purpose in taking discharges quietly away; on the other hand there can only be negative evidence that buildings protected on the net-work system, with many points, are not liable to be damaged.

17. The writer trusts that these notes will be of service and would conclude by making the following suggestions :—

a. Use as many points as possible (paragraph 9)—three short points placed ten feet apart on a roof ridge are much better than one elaborate and expensive three-pointed terminal.

b. Use galvanised wire of small section and interconnect all points on the roof. The lighter the gauge of wire used the greater the area of roof covered for the same outlay. (paragraph 7).

c. Avoid sharp bends and turns in the wire. Side flashes are apt to jump off from an abrupt bend or kink, which may cause damage to the adjacent masonry.

d. Connect in the roof gutters. Actual jointing is unnecessary and it will usually be found convenient to have the wire from corner points laid along the guttering and thence through down pipes to earth.

e. Take the earth connection away to a deep "earth" even if it is necessary to go a considerable distance from the building, The additional area of "surface" earth is useful, and the cost of wire and extra trenching is small.

f. Avoid joints as much as possible. Joints between the ordinary points and the wire forming the conductor are frequently made disgracefully, and, in numerous instances, the writer has found an actual break in continuity. The difficulty of supervising explains this—in fact the work is often left entirely to native workmen—and the remedy which suggests itself is that of adopting some practically jointless system.

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